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Implementing the Computer-Supported Collaborative Learning and Teaching in a Statistics Class for the Engineering Students

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Abstract. Teaching statistics for non-statistics students is a quite daunting job. The students need to understand the concepts and capable to apply them to solve the pseudo and real problems. Traditional teaching method is mostly one direction, from the lecturer to the students. Therefore, it is solely a lecturer responsibility to make the students enjoying and understanding statistics. The implementation of the new teaching method by incorporating another lecturer, student and statistical software R in the learning process give very positive results. Beside, the students learn on how to build a solid team to finish and defence their projects, at the end of the project it is clear that the students' levels of understanding about statistics are better than the previous year one which was without the project. The students' scores based on the final project report, the homework and the written exam are increased. In continuing the teaching method, we learn that it is suitable more for the small class only (10-20 students). For the bigger class then we suggest to work with some teaching assistants to help during the computer sessions.

1. Introduction

Industrial Statistics is one of the courses at the Industrial Engineering Department at the International Program Universitas Islam Indonesia (IE-IP UII) where students start to learn the inferential statistics. Students are introduced to some statistical methods that could be used to do the inference based on data at hand. The understanding of students toward the methods in this course will help students to do the data analysis for their final task assignments or at work after the graduation.

For universities in Asia, the international program, where all courses and communication are in English, has gained popularity among students and parents. On the other hand almost all of the lecturers are local native. In general, there are non-English natives nor coming from the country where English is their official language. Therefore, students lack to have an experience to be taught and academically interact with English native lecturers. This is happened at the IE-IP UII.

The experience with students at the IE-EP UII could be summarized as follows:

1) Most of the students tend to speak their national language during the class discussion. Motivate and encourage them is rather a big challenge.
2) Reading assignments did not work well as have been expected. Some students do not understand and or get confused on how to solve the exercises problem.
3) Introducing computer (statistical software) into the teaching process and providing a clear lecture notes (modul) help students to enjoy the course.

4) The average of exams scores is not high, 64.88 (less than 70) in 0-100 scales.
5) Student capabilities are varies; highly differ from one to the others.

The students evaluations informs that students prefer to have a

1) Lecture deliveres clearly such that it is easy to under- stand and not boring
2) Lecture deliveres in motivating and inspiring style
3) Lecturer provides students with interactive and communicative class
4) Lecturer prepares the materials suitable to the students ability/need

Based on above then the problem statements are as following

1) How to improve students habit in speaking English during the class
2) How to get students an experience to be taught by an English-speaking lecturer?
3) How to use and incorporate technology in teaching to prepare the teaching material and to make it an enjoyable teaching?
4) How to integrate the statistical software in the Industrial Statistics' class in order to help students to get a better understanding on how the statistical methods are implemented
5) How to improve the average of exams scores and students' understanding of the course contents

The purpose of the paper is to provide results the implementation of the combination methods of collaborative and computer supported learning and teaching. The paper is organized as follows. In Section 2 the experience of teaching statistics for the engineering students is presented. Section 3 describes the research methodology. Section 4 describes the results. Finally, section 5 is the conclusion.

2. Teaching statistics for the engineering students

In Fajriyah [3], it has been explained that the usage of computer for data analysis, indeed, has been implemented at the IE-IP UII through the practical computer course. But there is no specific practical computer course for the Industrial Statistics subject. Therefore students do not get directly a software statistical assist when they have the data analysis problem. They should learn on how to do it in statistical software statistics by themselves. In this case we see that there is a gap between the student knowledge about statistical methods theoretically and the implementation of those methods on computer to solve the data problem at hand.

When we have a rather large data, to solve the data analyse problem manually does not always easy and practical. If we do not careful enough then the result would be wrong and uneasy to be checked. It will lead students to a frustration state and all become difficult and are not interesting. As the result, students will get a view and impression that statistics is not an easy subject.

We try to keep away those opinions from students, because Industrial Statistics is a course in an early semester of their studies at the Department. We would love to see them enjoying their first encounter with statistical methods to analyse data and spread their knowledge to help other students in their neighbourhood.

Therefore, giving them the happiness and interested about this course and how enjoyable the learning experience in a class is very important. Somehow, this could be achieved by implementing a particular method of learning and teaching. Integrating the teaching method with the technology and implementing a collaborative teaching could be an option to improve the teaching results when the semester is ended.

The positive results could be assessed on how the students successfully solving the data analyse problem (small project), solving the Industrial Statistics exercises and how the attitude students toward this course and its teaching method. By implementing new method, we assume that students would be very motivated and inspired to learn and enjoy about Statistics.

3. Research methodology

3.1. Literature review and the chosen learning model

Smith and MacGregor [7] and Dooly [6] explains that collaborative learning is a learning system where lecturer does not a center any more in teaching, but lecturer and students together actively involve in it. Collaboration means the whole process of learning, which is including students teaching each other, students teaching teacher and teacher teaching students. Students work in a group (one group contains 2-3 students) to work together to understand, solve, interpret and create a product. Dooly [6] emphasizes that in collaborative learning, students are responsible for one another learning as well as their own. As a consequence, students have helped each other to understand and learn.

Villa, Thousand and Nevin [10] mention that collaborative teaching could be defined as two or more lecturer responsibility sharing for teaching some or entire students in a class room. The responsibility sharing includes planning, instruction, and evaluation students in a classroom. Walter-Thomas, Korinek, McLaughlin, Williams [11] and Villa, Thousand and Nevin [10] said that the positive things of collaborative teaching in comparison to the non collaborative's teaching, are:

1) Giving teaching variation for students
2) Enriching students knowledge and language 3) Assessment toward student understanding about the subject more objective
3) If it is in parallel class, then the content for each class
4) would be equal
5) If the collaborator is from abroad, then it would enrich
6) students and local lecturer knowledge and experience based on teaching method and culture of the collaborator origin. Also to improve lecturer and students foreign language (i.e. English)
7) Sharing and learning about responsibility and strategy in teaching, especially from the senior lecturer to the junior one
8) It does not drain your energy and more an enjoyable teaching process

Collaborative learning is based on discussion and active learning of students about learning content in a class. In this case lecturer does not think that he is an expert who transfers his knowledge into students, but more as an expert in designing the students intellectual experience (as a guide) or a helper in learning processes. This is in line with the philosophy of Abdu (De-Groot and Drachman, 2012).

Ludvigsen and Mørch [5] and Stahl, Koschmann and Suthers [8] explain that computer supported (CS) learning is a learning system which concerns on how information technology and communication support the students learning. This CS will

1) Help student to understand the subject with the assist of statistical software
2) Make student understand the implementation of statistical method for data analysis with the assist of statistical software
3) Help student to choose and apply statistical method via statistical software
4) Help student to know the free and paid statistical soft- ware for data analysis
5) Help student to understand the role of technology in statistics

Combine the collaborative learning and computer supported learning produce a new paradigm in learning process as a computer supported collaborative learning (CSCL). Where since 2006 there is a devoted journal on this computer-supported collaborative learning. De Corte [1]; Lehtinen, Hakkarainen and Lipponen [4]; Verschaffel, Lowyck, De Corte, Dhert and Vandeput [9] stated that CSCL is referred as the most promising innovation to improve teaching and learning process with the assist of information and communication modern technology. In a very simple statement Stahl, Koschmann and Suthers (2006) define that CSCL is the learning science concerned with studying how people can learn together with the help of computers.

Therefore, based on

1) Students evaluation
2) Positive view on collaborative teaching and CSCL from

the experts as have been explained above then we decide to implement the two combinations of computer supported collaborative learning and teaching (CSCLT) on the teaching and learning process for the Industrial Statistics class at Industrial Engineering Department.

The steps are as following

1) First, we will change the teaching method to the collaborative teaching.
2) Second, we will implement a collaborative learning (CL).
3) Third, we will implement the computer-supported (CS) in learning and teaching**.**

Further, we collaborate with a native English-speaking lecturer from abroad, who has internationally known in the field of Statistics. In diagram, the current and the proposed method can be summarized in Figure 1

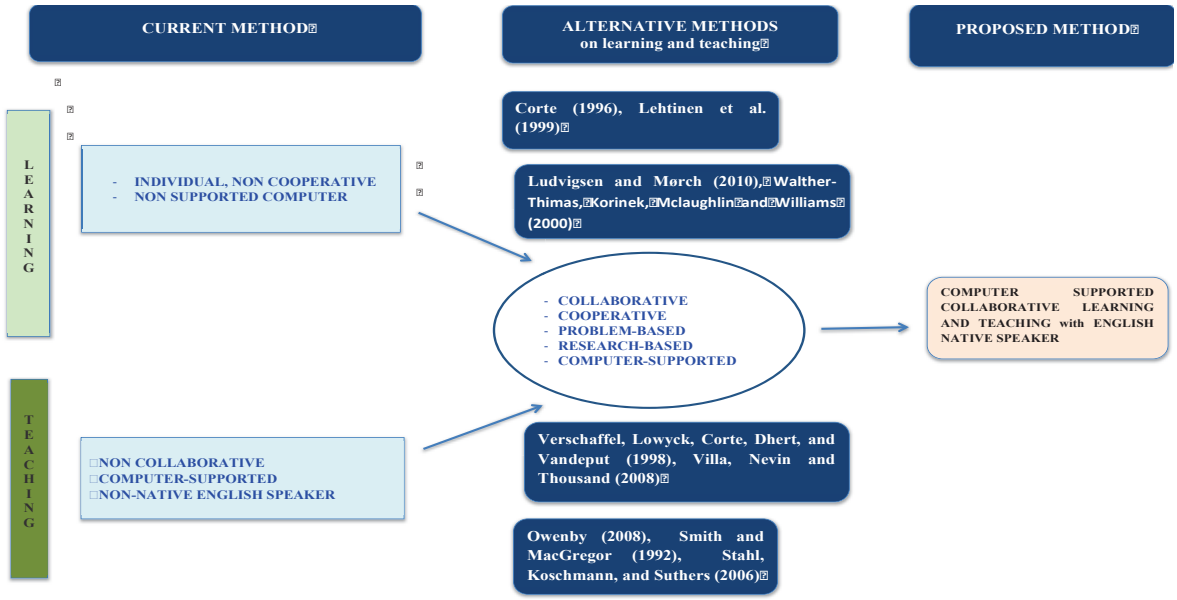

Figure.1. Research summary.

3.2. Design activities

There are two activities in this program:

1. *Activities outside the class:* Outside class activities mean as the activities for the collaborator with students outside the class, such as cultural activities
2. *Activities in the class:* Activities in the class are related in to the teaching activities, based on the RPS (teaching design for one semester). In order to implement the new teaching and learning method then first we divide students into some groups (2-3 students per group). Senior/bright student is the person in charge for each group as the leader and mediator to the lecturer. Second, we separate the course contents into some sections. These sections are designed to make assessing students competence in the course easier than the traditional learning, to provide a project presentation topic and also to plan the statistical software implementation. We also divide the material on the RPS in to two parts, first part (before midterm exam project) is for the local lecturer and the second one (after midterm exam) is for the collaborator.

3.3. Evaluation

The activities of CSCLT are evaluated as in the Table I as at column 3 (the Evaluation Method).

Table 1 Evaluation.

No.	Problem	Evaluation method	Indicator(s)	Outcome
1	How to improve students habit in speaking English during the class	Questionnaire	Positive review from collaborator about students and the program	Collaborator review about a. students: 3.85 b. the program: 5
2	How to get students an experience to be taught by an English-speaking lecturer?	Questionnaire	Positive review from students about collaborator and the program	Students review about a. collaborator: 4.06 b. program: 3.92
3	How to use and incorporate technology in teaching to prepare the teaching material and to make it an enjoyable teaching?	1. Questionnaire 2. Exam 3. Project Presentation assessment 4. Lecture notes and lab activity per competency group	a. Positive student's review about the program b. Average of exam score will increase c. Project presentation files and score d. Draft of lecture notes and lab activity handbook are available	a. Students review about the program: 3.92 b. Average exam score: 82.71 > 64.88 c. See Appendix 4 d. See Appendix 5
4	How to integrate the statistical software in the class of Industrial Statistics in order to help students to get a better understanding on how the statistical methods are implemented	1. Questionnaire 2. Exam 3. Project Presentation assessment 4. Lecture notes and lab activity per competency group	a. Positive student's review about the program b. Average of exam score will increase c. Project presentation files and score d. Draft of lecture notes and lab activity handbok are available	a. Students review about the program: 3.92 b. Average exam score: 82.71 > 64.88 c. See Appendix 4 d. See Appendix 5
5	How to improve the average of exam's scores and student understanding of the course content	1. Project's assignment assessment 2. Lecture notes and lab activity per competency group	a. There is a check-list assessment for the project assignment b. Draft of lecture notes and lab activity handbook available c. The average exam scores is increase, 70 in 1-100 scales	a. See Appendix 4 b. See Appendix 5 c. Average exam score: 82,71 > 70
6	Collaborative learning and teaching	1. Questionnaire 2. Handbook on how to implement the collaborative learning and teaching	a. Positive review from students about the learning and teaching method b. Draft of CSCLT handbook is available	a. Students review about the program: 3.92 b. See Appendix 5
7	Improving students assessment (NKD) toward local lecturer	NKD questionnaire	The improvement on NKD	The NKD is improved from 4.33 to 4.5

4. Results

4.1. Findings

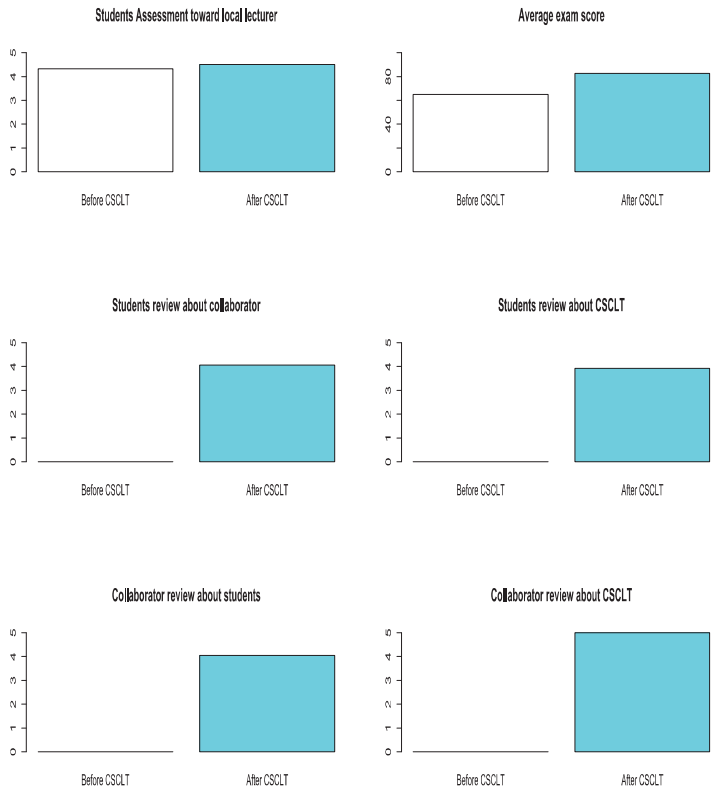

Figure.2. Results performance.

The implementation of CSCLT program at the Industrial Engineering Department and based on data analysis, can be seen at Table I, Figure 2. The following are the summary of all results

1) The review from the collaborator about students English are fair and but their habit to speak in English are improved. Communicating with the collaborator forced them to speak English, because they have no choice. With the local lecturer, they have a chance to not speaking English when they could not explain their purpose in English
2) Before the midterm exam, students review about the class is decreasing toward 4.1 and after the exam it was improved. This happened because this is a new program and students are not familiar yet with the CSCLT approach. Students midterm exam scores also increase toward 73.57 (and for the final exam is 82.71), students learn on how to prepare and delivery the presentation and to make a final project report. Their writing tend to be better than their speaking. Both of the local and collaborator provide the lecture notes for the program.
3) Collaborator gives a review that students knowledge about data analysis are improved but they still need to improve the familiarity in R software. The students are helping each other to understand the course material, which is a good sign of the collaborative learning implementation
4) In implementing the CSCLT, we combine the project assignment in a group and the individual task. There is no written exam, but the presentation one. We gave the weight for the report is 40%,

the presentation is 30% and the oral exam is 30%. We combine the final score for them as the midterm exam 35%, the final exam 35% and the individual task 30%

5) Students give a review for the instructor as very good in English, in his expertise in Statistics and using the statistical software, threat the students with respect, encouraging students to ask and give the answer, explain material clearly, well prepared and help students to understand the material
6) Students perceive that the teaching assistants help them to understand the material and statistical software and also provide them the consultation outside the class

Beside the positive reviews, there are some drawbacks in the implementation of CSCLT. The drawback in the implementation is, the current's implementation of 3-4 students per group is in effective, because there is always one-two members who do not actively involved in the discussion and questions-answers during the presentation. The smaller member for each group, it is the better. It has to be maximum 2 members. Therefore, in the final exam project, we change the group in the exam project, which is maximum containing 2 members. The consequence is we have to provide more teaching assistants.

4.2. Contribution

Based on the activities have been designed, these lead to the contribution as follows [3]:

1) It gives a new paradigm on how to teach the Industrial Statistics at the Industrial Engineering Department.
2) There is some knowledge transferred from both parties. Particularly from the collaborator to the host. Including some information on the implementation of statistical methods in industries. As the English habit speaking students are improved as well
3) There is a teaching sharing experience from both sides. The collaborator shared his teaching method at his institution to improve students understanding about statistical methods in industry.
4) The use of technology/computer in teaching process was increased, see the RAPS in [3]
5) The average (and median) score on the final exam of Industrial Statistics has increased, p-value < 0.05 by the t and cross-variance tests [2].
6) Students to become critical thinker and actively asking the questions.
7) Students review about the class has improved, from 4.33 to 4.5
8) The lecture notes based on the RAPS are available

5. Conclusion

In general, the implementation of CSCLT brings the positive reviews from students, teaching assistants, staffs, collaborator and the department. The method has improved students' knowledge in the subject, familiarizing students with the statistical software and promoting cooperation among students in the learning process. By providing an English native collaborator, then students learning by doing on communicating in English for the academic purposes. The use and integrate the information technology have been well experienced by the students particularly in using the statistical software. By that, we provide students the experience on how to analyse and take the conclusion with it. In case other classes would like to implement the CSCLT program, the guidance book on how to do that in the class has been provided.

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